

## **REMARKS**

In view of the foregoing Amendments and following remarks, reconsideration and allowance of the present application are respectfully requested.

In general, the present invention is directed to methods of making optical devices and optical devices formed by the disclosed methods. More specifically, the optical devices of the present invention may include films formed from perfluorocyclobutyl (PFCB) copolymer compositions. For instance, claim 1 of the present application is directed to a method which includes providing a perfluorocyclobutyl copolymer composition having the disclosed structural formula and a solids content of greater than 50% and spin coating the composition to form a film of an optical device. For instance, the PFCB copolymer films formed according to the methods of the present claims may be cores and/or clads of optical waveguides.

Presently pending U.S. Patent Application Serial Number 09/604,748 was previously cited as an application which is related to this pending application. Applicants would like to clarify that the commonly assigned application was cited to the Examiner for review and consideration, and the present application does not claim priority to Application No. 09/604,748.

In the Office Action, the specification was objected to under 35 U.S.C. §112, first paragraph.

In the Applicants' previous response, dated February 3, 2003, the specification was amended at Table 2 on page 14; at page 15, line 28; at page 16, line 20; and at page 17, line 26. In the Office Action, removal of these amendments was called for. Applicants respectfully request reconsideration of this requirement.

Page 15, line 28 of the present application is a heading for Example 2, the description of which follows the heading. In the Example, 40 g of pure monomer 2B, 40 g of pure monomer 2A and 10 g of filtered mesitylene was added to a three neck round bottom flask. The weight percent of the monomers in this solution is correctly calculated to be 89% (a total of 80 grams of monomers in a total of 90 grams of solution, or 80/90).

In the originally filed specification, the heading for Example 2 read that the solution was 80 wt% in mesitylene, which was in error.

Page 16, line 20 of the present application is a heading for Example 4. In the description of the Example which follows the heading, 17.4 g of pure monomer 2B, 7.8 g of pure monomer 2C, and 8 g of filtered mesitylene were added to a flask. The weight percent of the monomers in this solution is correctly calculated to be 76% (a total of 25.2 grams of monomers in a total of 33.2 grams of solution, or  $25.2/33.2$ ). In the originally filed specification, the heading for Example 4 read that the solution was 75 wt% in mesitylene, which was in error.

Page 17, line 26 of the present application is a heading for Example 7. In the description of the Example which follows the heading, 80 g of pure monomer 2B, 40 g of pure monomer 2A, and 20 g of filtered mesitylene were added to a flask. The weight percent of the monomers in this solution is correctly calculated to be 86% (a total of 120 grams of monomers in a total of 140 grams of solution, or  $120/140$ ). In the originally filed specification, the heading for Example 4 read that the solution was 70 wt% in mesitylene, which was in error.

Applicants respectfully submit that these errors were obvious errors, the existence and correction of which would be recognized by one skilled in the art. As such, the amendments do not constitute new matter, and reconsideration of the call for the removal of the amendments is requested.

Table 2 includes a column summarizing the wt% polymer in mesitylene for all of the examples. The amendments to Table 2 in the previous response correct the figures in the table related to the correction of the obvious errors in the above-described Examples. As such, Applicants respectfully submit that the amendment does not constitute new matter, and reconsideration of the call for the removal of the amendment is requested.

In the Office Action, Claim 28 was rejected under 35 U.S.C. §112, second paragraph.

Applicants have corrected the typographical errors in Claim 28 with the presently proposed amendments and believe the presently amended claim 28 fully complies with 35 U.S.C. § 112.

In the Office Action, Claims 29, 30, 32, and 45-47 were rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over Shah, et al. (Polymer Preprints, Vol. 40(2) pp. 1293-1294, 1999).

In the present amendment, claims 30, 32, and 45-47 have been cancelled. As such, rejections to these claims throughout the following remarks have not been otherwise addressed. Claim 29 of the present application is directed to an optical device. The methods utilized in forming the device include spin coating a PFCB-based copolymer composition of greater than 50% solids to form a first film. The film forms a core in an optical device.

Shah, et al. discusses the combination of thermally robust aromatic ether units with PFCB linkages and a unique crosslinking mechanism to give high  $T_g$  amorphous networks with tunable optical and thermal properties. According to Shah, et al., the thermal cyclopolymerization of aryl trifluorovinyl ether monomers to PFCB polymers affords material for potential use in optical communication devices.

Shah, et al., as pointed out in the Office Action, discloses the formation of a 50 wt % copolymer of TVE-co-BPVE. However, there is no teaching or suggestion found in Shah, et al. that the disclosed copolymer could form a core of an optical device, as is taught in claim 29 of the present application. For instance, while Shah, et al., states that the copolymer exhibits low loss in the wavelength range suited for optical waveguide applications (page 1294, first column), the reference does not suggest what these applications might be. Specifically, the reference does not suggest that these applications may include utilizing the copolymer material as a core of an optical device.

Applicants further submit that the method of forming the core of the optical device as taught in claim 29 is neither anticipated by nor obvious over Shah, et al. For instance, while Shah, et al. teaches that thermoplastic solutions or pre-thermosetting

cases composed of hyper-branched oligomers can be melt processed or spin-coated (page 1293, second column), no specific teaching of the spin-coating methods are disclosed. Specifically, no reference is found as to the weight percent solids possible in the solutions as they are spin coated. The reference does not disclose or suggest a core of an optical device that may be formed by a method which includes spin-coating a copolymer composition at a solids concentration of greater than 50%, as in disclosed in claim 29 of the present application.

Applicants respectfully submit that presently pending claim 29 patentably defines over Shah, et al.

In the Office Action, Claims 29, 30, 32, and 45-47 were rejected under 35 U.S.C. §102(b) as being fully anticipated by or alternatively under 35 U.S.C. §103(a) as obvious over Smith, et al. (J. Fluorine Chemistry, Vol. 104(1), pp. 109-117).

Smith, et al. discusses formation mechanisms for PFCB polyaryl ethers. Specifically, the references discuss the development of an intermediate strategy utilizing Grignard and aryllithium reagents which offers access to a wide variety of hybrid materials amenable to coatings applications (Abstract). Throughout Smith, et al. reference is made to the utilization of the materials (which does include certain PFCB copolymer materials) in coatings applications. In the optical device of claim 29 of the present application, however, the copolymer film forms a core of an optical device, as opposed to, for example, the optical cladding layers disclosed in Smith, et al. There is no reference found in Smith, et al. that suggests that the materials may be utilized in such an application, that is, as a core of an optical device. As such, Applicants respectfully maintain that claim 29 of the present application patentably defines over Smith, et al.

In the Office Action, Claims 29, 30, 32, and 45-47 were rejected under 35 U.S.C. §102(b) as being fully anticipated by Babb, et al. (U.S. Patent No. 5,426,164).

Babb, et al. '164 is directed to a photoimageable polymer which has at least one photoactive site and more than one perfluorocyclobutane group. The polymers are

useful in coatings, photoresists, and the like (Abstract). The photoactive polymer coatings of Babb, et al. '164 are advantageously prepared in a solvent, applied to a surface, and exposed to photonic radiation of a wavelength which, preferably, renders the polymer less soluble or dispersible (col. 20, lines 13-31). No reference is found or suggested in Babb, et al. '164 that the polymers may be utilized as a core in an optical device, as is taught in the optical device of claim 29. In addition, a process for forming the film which includes spin coating a PFCB copolymer solution provided at greater than 50 wt% solids content is not found or suggested in the reference. As a claim is anticipated only if each and every element as set forth in the claim is found in a reference, either expressly or inherently described, Applicants respectfully submit that Claim 29 is not anticipated by Babb, et al. '164.

In the Office Action, Claims 29, 30, 32, and 45-47 were rejected under 35 U.S.C. §102(b) as being fully anticipated by Babb, et al. (U.S. Patent No. 5,159,038).

Babb, et al. '038 is directed to a process for preparing a polymer having PFCB rings. Exemplary products of the patent include low dielectric fluids and lubricants (col. 2, line 68). No reference is found in Babb, et al. '038 that the polymers may be utilized as a core in an optical device, as is found in the optical device of claim 29. In addition, a process for forming the film which includes spin coating a PFCB copolymer solution provided at greater than 50 wt% solids content is not found or suggested in the reference. As a claim is anticipated only if each and every element as set forth in the claim is found in a reference, either expressly or inherently described, Applicants respectfully submit that Claim 29 is not anticipated by Babb, et al. '038.

In the Office Action, Claims 1-17, 19, 22-26, 29, 30, 32, 33, 35, 36 and 45-47 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. (U.S. Patent No. 5,246,782).

Smith, et al., Babb, et al. '164 and Babb, et al. '038 disclose certain PFCB copolymer networks. While each of these references generally refer to coating methods for forming films of the materials, and specifically refer to spin coating as a possible

method for forming films of PFCB materials, none of these reference disclose or suggest the possibility of spin coating a copolymer solution of greater than 50 wt% solids to form films of the materials. Kennedy, et al. discloses TVE homopolymer networks which may be spin coated from TVE monomer at 50 wt%, 60 wt%, and 70 wt% solutions solids content.

Applicants respectfully maintain that there is no motivation to combine the references as suggested. Specifically, Applicants maintain that the copolymer materials of Smith, et al., Babb, et al. '164 and Babb, et al. '038 are different materials with different chemistries as compared to the homopolymer material of Kennedy, et al. that can be spin coated at high solids content, and there is no motivation to combine the references. Particularly, there is no motivation to combine the coating method which is possible for the homopolymer material in Kennedy, et al. with the different copolymer materials of Smith, et al., Babb, et al. '164 or Babb, et al. '038.

As discussed in the instant application at page 4, when “forming a polymer film using spin coating techniques, it is necessary to form a coating of sufficient thickness to manufacture a waveguide. Many polymers cannot be dissolved at solids content when spin coated to manufacture a suitable waveguide thickness. In many instances, it requires multiple coats of polymer to achieve the necessary thickness.” (emphasis added). Thus, just because one polymer may be dissolved at sufficient solids content and spin coated to form a thick film, that doesn't mean that another, different polymer may also be dissolved at sufficient solids content and spin coated to form a thick film.

A homopolymer will not have the same chemistry as a copolymer which incorporates the monomers found in the homopolymer as one component of the copolymer. As the chemistries of two different homopolymers are different from each other, it necessarily follows that the chemistry of a copolymer comprising both monomers will be different from the chemistry of either homopolymer. In other words, the solubilities, the thermodynamic properties, the optical properties, the mechanical properties, the reaction kinetics, the functionalities, the stereochemistry, in fact the very nature of a copolymer is different from any of the homopolymers formed from the same individual monomers. In other words, a copolymer is a different material from any of the

homopolymers which may be formed of the monomers found in the copolymer. As such, Applicants respectfully maintain that there would be no motivation to combine the copolymer materials found in Smith, et al., Babb, et al. '164 or Babb, et al. '038 with a coating process suitable for a different material such as the high solids content spin coating process of Kennedy, et al. suitable for a homopolymer material.

As such, Applicants submit that the presently pending claims directed to spin coating a PFCB copolymer composition of greater than 50 wt% solids patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al.

Applicants further submit that even if the references were combined as suggested in the Office Action, absent motivation to do so, the combination of references still fails to disclose elements of certain of the rejected claims. More specifically, none of Smith, et al., Babb, et al. '164, Babb, et al. '038 or Kennedy, et al. disclose or suggest the claimed processes or products wherein a film formed of a PFCB copolymer network may be a core in an optical device as taught in presently pending claims 16, 18, 19, 22-26, 28, 29, 33, 34 and 36-44, certain of which having been rejected under this section of the Office Action. Specifically, Smith, et al., Babb, et al. '164 and Babb, et al. '038 disclose processes and products as discussed above, none of which include forming the core of an optical device from a PFCB copolymer network. Kennedy, et al. is directed to laminates of the disclosed polymers. Kennedy, et al. discloses a great number of possible uses for the polymers throughout the patent (see, for example, the section beginning at column 16, line 47 and extending to the Examples section). However, the bulk of the applications are limited to exterior layers, dielectric layers, and reinforcing layers (col. 16, lines 41-45) and possible application of the disclosed polymers as a core of an optical device is not found among the many uses for the polymers of Kennedy, et al.

As such, Applicants submit that the presently pending claims directed to a core of an optical device formed from a PFCB copolymer composition patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al.

In the Office Action, Claims 1-17, 19, 22-26, 29, 30, 32, 33, 35, 36 and 45-47 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al., Babb, et al.

'164, or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al. (Electron. Lett., Vol. 33(6), pp. 518-519, 03/97).

In the Office Action, Fischbeck, et al. was cited as teaching optical waveguide coatings of 10 microns for TVE-PFCB polymers. Fischbeck, et al. describes a TVE-PFCB polymer and presents the loss spectrum measured on a single mode waveguide. However, Fischbeck, et al. does not disclose or suggest spin coating a copolymer solution of greater than 50 wt% solids, as is taught in presently pending claims 1-15, 19, 29, 33-35, and 41-44. In addition, Fischbeck, et al. does not disclose or suggest that the single mode waveguide may be a core in a core/clad optical device, as is taught in presently pending claims 16, 18, 19, 22-26, 28, 29, 33, 34 and 36-44.

As Applicants have previously submitted that the presently pending claims patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al., as discussed above, Applicants further submit that Fischbeck, et al. does not cure the defects of this previously argued combination, and therefore the rejected claims also patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al.

In the Office Action, claims 1-19, 22-26, 28-30, and 32-47 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al. and further in view of Shacklette, et al. (U.S. Patent No. 5,850,498), Shah, et al. (Polym mater. Sci. & Eng, 2000, Vol. 82, p. 300) and Kaneko, et al. (U.S. Patent No. 6,438,307).

Shacklette, et al. is directed to low stress optical waveguide assemblies wherein one or more waveguide cores have a conformal cladding attached. Flexible, low glass transition temperature polymers are used to form the core of the devices (col. 5, lines 53-63). Neither the core nor the clad of the devices are disclosed or suggested to be formed of PFCB materials. The materials used to form each of the cladding and core comprise a photopolymerizable compound and a photoinitiator generally, and multifunctional acrylate monomers are preferred (col. 5, lines 28-44). Applicants respectfully submit that there is no motivation or suggestion that the teachings of



Shacklette, et al., directed to optical devices formed of low  $T_g$  polymers may be in any proper way combined with the teachings of the other references. In fact, Applicants submit that the references themselves teach against any combination, in particular as all of the other references are specifically directed to high  $T_g$  materials of various types and teach the preference of high  $T_g$  materials over low  $T_g$  materials, such as those taught by Shacklette, et al.

Shah, et al. (Polym mater. Sci. & Eng. 2000, Vol. 82, p. 300) discloses the combination of high  $T_g$  PFCB aromatic ether polymers with carbon nanotubes to give property tunable thermoplastic and network composites. The reference does disclose physical characteristics of a certain 50:50 weight percent PFCB copolymer. Applicants have previously submitted that the presently pending claims patentably define over the other cited references, as discussed above. Applicants further submit that Shah, et al. does not cure the defects of the previously argued combinations. For instance, Shah, et al. does not disclose or suggest spin coating a PFCB copolymer solution of greater than 50 wt% solids, as is taught in presently pending claims 1-15, 19, 29, 33-35 and 41-44. In addition, Shah, et al. does not disclose or suggest a PFCB copolymer material formed as a core in a core/clad optical device, as is taught in presently pending claims 16, 18, 19, 22-26, 28, 29, 33, 34 and 36-44. As such, Applicants respectfully maintain that the presently pending claims patentably define over the cited references in any proper combination.

Kaneko, et al. is directed to optical waveguides for use in optical communication modules. The optical waveguides of Kaneko, et al. are core/clad optical devices. The optical waveguide of Kaneko, et al. includes a substrate, a lower cladding layer, and an intermediate layer. A core and a cladding are formed in the intermediate layer. The intermediate layer is formed from an optical material whose refractive index varies corresponding to the irradiation amount of light having energy higher than that of the guided light and decreases within a predetermined range of irradiation amount of light. The cladding of the intermediate layer is formed by irradiating regions of the intermediate layer on both sides of what will be the core so as to make the refractive index of the clad part less than that of the core part. The complete cladding portion of

the optical waveguide is constituted by the lower cladding layer, the cladding parts formed in the intermediate layer, and an upper cladding layer (col. 7, lines 15-43). The material of the intermediate layer is a siloxane polymer in which siloxane bonds are formed by the irradiation with light (col. 3, lines 46-48). Thus, Kaneko, et al. teaches a single layer of one material the refractive index of which may be differentiated through irradiation to form a core and a clad.

Applicants respectfully submit that there is no motivation to combine the teachings of Kaneko, et al., in which a core and clad are formed from a single layer of a variably irradiated siloxane polymer, with the teachings of any of the other cited references, and particularly with Smith, et al., Babb, et al. '164, Babb, et al. '038, Kennedy, et al., Fischbeck, et al. or Shah, et al. (Polym mater. Sci. & Eng, 2000, Vol. 82, p. 300) which are directed to a variety of possible uses of PFCB materials.

Moreover, Applicants further submit that even if one were to combine the teachings of Kaneko, et al. with any or all of Smith, et al., Babb, et al. '164, Babb, et al. '038, Kennedy, et al., Fischbeck, et al., Shacklette, et al. or Shah, et al. (Polym mater. Sci. & Eng, 2000, Vol. 82, p. 300), absent any motivation to do so, any combination of references still fails to disclose processes or products wherein a film formed of a PFCB copolymer network may be a core in an optical device as taught in presently pending claims 16, 18, 19, 22-26, 28, 29, 33, 34 and 36-44. In addition, any combination of the cited references still fails to disclose processes or products wherein both the core and the clad of an optical device may be formed of PFCB copolymer films, as taught in presently pending claims 18, 28, 34 and 37-44.


It is believed that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested.

Even if the Examiner is not swayed by the above remarks, Applicants request the entry of the proposed Amendments so as to present the rejected claims in better form for consideration on appeal. Examiner Angebranntdt is invited and encouraged to telephone the undersigned, however, should any issues remain after consideration of this response.

Please charge any additional fees required by this Amendment to Deposit  
Account No. 04-1403.

Respectfully submitted,

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